

Project Title

**Conservation Outreach and Assistance to
Disadvantaged Arkansas Farmers**

Project Manager

J. D. Davis

Period of Performance

10/01/2010 – 9/30/2013

Agreement Number

NRCS AGREEMENT #69-3A75-10-164

Date of Submission

12/31/2013

Project Deliverables

- ✓ Comprehensive farm nutrient management plans were developed
- ✓ A case management model for enrolled participants that will assess current site operations, identify opportunities for controlling nutrients and identifying priorities for avoiding and trapping nutrients was implemented
- ✓ Farmers and landowners were assisted in enrolling and participating in one or more NRCS programs.
- ✓ Farmers were assisted in completing a conservation plan and incorporating the use of perennial energy/biomass crops
- ✓ A Demonstration site was conducted in along with two annual training conferences
- ✓ A new technology and innovative approach fact sheet was produced and distributed
- ✓ One NRCS CIG showcase or comparable NRCS event during the period of the agreement
- ✓ Provided the Natural Resources Conservation Service with quarterly progress reports and a final report

TABLES OF CONTENTS

1.0	EXECUTIVE SUMMARY	4
2.0	INTRODUCTION	6
3.0	BACKGROUND	7
4.0	REVIEW OF METHODS	9
5.0	DISCUSSION OF QUALITY ASSURANCE	10
6.0	FINDINGS	11
7.0	APPENDICIES	16
8.0	CONCLUSIONS AND RECOMMENDATIONS	22
9.0	TECHNOLOGY REVIEW CRITERIA	23

1.0 EXECUTIVE SUMMARY

The Arkansas Land and Farm Development continued its outreach to underserved farmers and ranchers in the Mississippi Delta. Emphasis was threefold: 1.) To increased enrollment in NRCS programs; 2.) To provide farm sustainability training through nutrient management, farm management, and resource conservation practices; and, 3.) To enhance economic development through farming activities. To facilitate the achievement of these objectives, a Farm Nutrient Management Plan was developed for farm clients. This plan serves to assess current site operations, identify opportunities for controlling nutrients and identifying priorities for avoiding and trapping nutrients. Also, a Case Management Tool for client tracking and management was implemented.

ALFDC accomplished the objectives of this project by recruiting clients and provided group and individual training and assistance. Over the course of the project eight (8) regional workshops were conducted. These workshops provided training on farm management and conservation stewardship. NRCS program services were briefed at all workshops. NRCS staff participated in these workshops and briefings. Client eligibility requirements were discussed and explained. Material, information and data relating to USDA programs were distributed. Staff continued with follow-up by assisting individual farmers in identification of conservation issues, leading to the development of the individual's farm plans. In the same process, EQIP and other programs applicable applications were identified.

Field agents followed up these meetings with their respective cases. Individual farmers were assisted on the farm and/or invited into the office for one-on-one training. Good Agriculture Procedures/Good Handling Practices (GAP/GHP) training was provided at regional workshops in McGhee, Arkansas. This activity led to the establishment of a GHP certified packing house which also serves as a marketing entity. This is paramount to fresh fruit production. That is, with a market, farmers are growing more fresh produce and utilizing more USDA programs to improve their farming operations.

Group training sessions were conducted followed by individual or one-on-one sessions. Topics included business planning, risk management, soil management, conservation stewardship, marketing, and analysis of USDA programs applicable to each case/farming operation. A major effort focused on farm management and outreach. Previous tasks were studied and assessed for effectiveness in terms of the number of clients being reached and served. An increased emphasis on heir's property (a barrier to services in many cases) was added to the training.

Field Day Events were an integral part of the project. The major focus of field days included grazing and pasture management, beef cattle health, care and herd management, nutrient management, soil care and protection, and, equipment maintenance.

A client management and tracking system was implemented as an Access data base, and was used to facilitate case management information/data storage, retrieval and management. New clients are added as they become project participants.

Research was performed to collect source material for the Nutrient Management Plan. The resulting plan serves as guidance and source material for clients. As an adjunct to the nutrient management plan, a collection of material from universities, government and other sources was assembled to serve as a resource center for nutrient management material. This material also aids our staff with nutrient training.

2.0 INTRODUCTION

Training and technically assisting African American farmers and other underserved groups in the conservation of natural resources were core elements of this project. Promoting a positive attitude toward conservation was paramount to getting participants to develop farm conservation plans, to try minimum-to-no tillage, and to systematically test their soils and apply nutrients responsibly. The Arkansas Land and Farm Development Corporation's (ALFDC) experience in providing training and technical assistance to African American and limited resource farmers proved to be very necessary on this project. The area served included, part of the larger Mississippi River basin, and, portions of the Lower Mississippi, White, and Lower Arkansas River watersheds. The three year outreach and assistance effort lead to a reduction of nutrient runoff and improved water quality through increased participation in NRCS programs by small farmers and the development of comprehensive farm nutrient management programs for individual farms.

The project also sought to increase earnings while strengthening the ability of participating farmers to sustain and grow their farming operations while reducing their adverse environmental impacts. These results were achieved by recruiting limited resource and socially disadvantaged farmers and land owners to attend local training sessions and working with them in continued conservation training. The project conducted two workshops and several field days each year in each of the four regions of the target area. These events were designed to increase awareness of conservation core practices that are relevant for the types of farm operations in that region and to increase knowledge of NRCS services and application procedures. The workshops averaged over 30 participants.

A case management model was developed and used to manage the design and delivery of the ongoing conservation development services for enrolled participants. The project's technical implementation included access to a consulting environmental engineer as well as the staff from collaborating universities, and Extension Service. State NRCS and local Conservation District staff were central collaborators in all project activities.

3.0 BACKGROUND

The project was implemented to increase African American farmer participation in and utilization of a number of USDA programs, including conservation programs under both NRCS and FSA, soil nutrient management compliant with NRCS 590 Nutrient Management Conservation Practice Standard, and biomass crop, and biomass crop demonstrations.

During the project's period of performance, the following activities were accomplished:

- Conducted regional workshops on NRCS program services including soil conservation, nutrient management, EQIP and CSP.
- Established demonstration plots of appropriate energy crops and woodland management practices for biomass production
- Conducted on-farm field day events and provide individual and one-on-one counseling.
- Established a library of relevant materials on nutrient management, farm management, and new technologies.

Arkansas Land and Farm Development Corporation is an established 501(c)(3) organization with a proven record of effectively providing training and technical support services to minority and limited resource farmers in Arkansas. This effort builds upon a record of over thirty years of training, technical assistance and advocacy for African American farmers. This record includes current and past efforts to:

- Improve soil fertility and accompanying increased capacity through effective nutrient management
- Assist minority farmers in taking greater advantage of USDA program services relating to natural resources conservation through the implementation of conservation plans for their farming operations.
- Assist farmers in becoming more aware of new and innovative technologies applicable to their farming operations.
- Encourage farmers to diversify their farms to include biomass crops.
- Develop and utilize a case management model to dynamically serve farm clients.
- Partner with USDA's Natural Resources Conservation Services to increase the understanding and utilization of NRCS program services.

The successful achievement of our outreach and assistance objectives in this project rests upon ALFDC's unique ability to knit together a collaborative network of USDA agency staff, rural community-based organizations, 1860 and 1890 University programs, and private sector resources to serve small and limited resource minority farmers.

Targeted farmers for this project have had limited exposure to advanced agricultural technology, innovative production systems, site specific nutrient management systems, biomass crops producible in the lower Mississippi delta, sustainable agricultural practices, value-added processing structures, and cost efficient marketing networks. As a result, they have been unable

to expand their operations, slow to adopt new production practices, and unable to increase their profitability. Cultural and demographic factors also affect their ability to participate in agricultural programs and to appreciate natural resource conservation.

4.0 REVIEW OF METHODS

The methodology utilized on this project was to employ an aggressive outreach effort to make farmers aware of USDA programs that offer sustainable benefits to their farming operation. Dissemination of information was performed in an easily comprehensive form allowing the farmers to understand the USDA available services as they could apply to their farm activities. Also, an extensive effort was employed to address the important benefits of conserving natural resources. Many of the project participants farmed land with poor soil fertility. Therefore soil nutrient training was key to their farm sustainability. These matters were addressed early on and continuously throughout the duration of the project through workshops, field demonstrations and individual counseling.

Two Regional workshops with participants from southern, central, east central and southwest Arkansas was held each year of the project. Also quarterly workshops were held in at least one region each quarter. These workshops were publicized as part of state wide events through ALFDC newsletter, local media, and through notices to local USDA NRCS and other agencies. The workshops included presentations by ALFDC staff and their collaborators, including representatives for USDA agencies on different management issues and on available USDA program service opportunities. Strategies for increased adoption of conservation practices, increased utilization of USDA program services, improving agricultural productivity, and community economic development were presented.

Supplementary to the workshops field day events and individual counseling were regularly conducted through the execution of the project. Benefits from these activities included:

- Continuing farm management assistance and monitoring
- Assistance and training on resources for energy conservation and opportunities for demonstration models for soil and water conservation management
- Counseling on farm development planning
- Assistance with applications for USDA assistance and services resulting in an increase in the number of farmers seeking continuing assistance in applying for and qualifying for USDA program benefits
- Received information and training on specific NRCS programs and services relating to bio-energy crops, conservation and financial resources of Natural Resources Conservation Service, Farm Service Agency and Rural Development

Follow-up activities with participants are on-going. This includes providing individual counseling with clients desiring additional information and explanations regarding program services and other outreach matters.

5.0 DISCUSSION OF QUALITY ASSURANCE

Reports, documents, flyers and promotional materials, and presentations and verbal communications done on this project were done compliant with professional and industry standards. Neither hardware products nor engineering drawings were produced for this project.

6.0 FINDINGS

The findings for this project are summarized as follow:

- The farmers and landowners participating in this project knew very little about most NRCS and other USDA program services that they could use to enhance their farming operations well as protect the environment, conserve natural resources and increase their potential profits with higher yields brought about by improved soil nutrient management practices.
- These farmers and landowners possessed a serious distrust of the USDA. This was partly due to a lack of understanding, unprofessional and demeaning reception at local service centers, and because of known discrimination issues.
- Heir property issues precluded some participants from meeting eligibility requirements in some cases.
- Most of these type of inhibiting factors can be overcome and an increase in USDA service participation can be achieved.

We also selected and investigated three biomass crops for production in this area. The results of this activity are presented below.

Three biomass crops were considered for small and limited resource farmers in the Delta. These crops are the grasses miscanthus giganteus and arundo donax and koriyanagi willow shrub. Below is a brief outline efforts to date with each of these potential crops and some of the critical issues in developing them as biomass crops for under-capitalized, limited resource farmers.

Miscanthus Giganteus

Miscanthus giganteus is a sterile, hot season perennial grass from Asia that has been used for biomass production in Europe since the 1980's. With a mature height of 9-12 feet and yields of up to 20 tons per acre when fully established, this C4 grass has good drought resistance and is a low input crop suitable for non-prime agricultural land. Propagation is generally by planting rhizomes harvested from established fields.

Miscanthus giganteus plants were acquired from a commercial Illinois source two years ago and we have been growing and dividing the plants. Currently, we have one 4x12 propagation bed and expect to establish three more propagation beds before September using the 200 potted and bagged (1 and 3 gal) plants, two trays, and 75 plants in deepots (2" x 7"). These containerized plants were divided this spring, and are shown in the following photos.



While miscanthus production has already begun at a number of sites in the Midwest and Mid-South, the establishment costs involved in rhizome planting and the two to three year wait for harvestable yields to be achieved create a substantial financial barrier to small and limited resource farmers. For this reason, we are exploring alternative propagation and crop establishment practices that will dramatically reduce this financial barrier. These alternatives will focus on avoiding the cost of harvesting and separating rhizomes from established fields and the use of low-cost or readily



C3
can
high
and

adapted planting equipment. Demonstration plots will be prepared this fall and planted in the Spring and Summer of 2012 using these alternative methods.

Arundo Donax

Arundo donax or Giant Cane is a, 18-30 foot perennial grass that has sterile seeds. Propagated through division of its large rhizomes, arundo yield 20-27 tons per acre on non-prime agricultural land, especially land that is prone to wetness. Arundo has particular value for its very rate of carbon sequestration in its large rhizome root structure.

Originally from Asia, arundo has been naturalized throughout all temperate to tropical regions of the world (zones 5 and higher). Long used as an ornamental plant and for the production woodwind reeds, arundo has become invasive in riparian areas of South Texas and California where does not have a winter dormant period and river currents have eroded the banks and washed out the rhizomes and canes. Eastern Arkansas has had a significant number of naturalized stands of arundo since the plant was introduced as an ornamental in 1940's and subsequently abandoned. These stands have not shown evidence of invasiveness.



of
it
the

Propagation of arundo through rhizome division is difficult and labor intensive because of its large, woody structure. Most efforts to utilize arundo for biomass production have depended on tissue culture for propagation. I have experimented with an alternative vegetative propagation method that harvests mature canes in late Summer and Fall, soaks them horizontally

in a plain water bath for 4-6 weeks to cause root and shoot development at cane nodules, and then planting the rooted canes horizontally in rows.



Three 4 x 7 beds were planted in this method last fall. While all three were initially productive, their winter survival rate – approximately 15%– proved unsatisfactory. Surviving plants in one of the beds is shown in a July 30, 2011 picture at the top of the following page.

Currently, I am transplanting additional arundo stock which has been grown in 3 and 5 gallon growing bags into the three propagation beds. In mid-August the mature canes in the propagation beds, along with canes from the parent naturalized stand, will be cut down, stripped of leaves and cut into 4 foot lengths for soaking. After roots and shoots have developed, they will be removed and planted into approximately 1,200 deepots for over-wintering under lights

and in a heated environment. In the Spring, these plants will be planted in three to four initial arundo test plots. Each test plot will consist of 9 fifty-foot rows with two foot spacing between rows and 1.5 foot spacing between plants.

In addition to testing this method of propagation, the test plots will be used to measure the rate of rhizome growth and spread to document arundo's invasiveness in this region under defined management practices. Additionally, once fully established, one of the test plots will be used to examine alternative methods of mechanical and chemical eradication.

Willow

Willow has been extensively used as a short-rotation woody biomass crop in both the northeast US and Europe. Hybrid willow varieties with the ability to coppice or resprout after cutting are able to achieve an annualized dry yield of around 4 tons per acre. While this is substantially less yield than grasses in the Delta region, willow's potential contribution to stream bank stabilization, wetland restoration and water and soil phytoremediation adds to its value as a potential plant for multiple uses, including biomass production.



The koriyanagi willow is an Asian shrub that has been extensively evaluated by the Plant Material Center in Coffeeville, MS, for its sustainability under Delta conditions. In January of 2011, I acquired 50 dormant whips of koriyanagi willow from the Center in order to propagate sufficient stock to test its performance in short-rotation coppice production. The plants were initially rooted in 5 gallon buckets in an unheated high tunnel and then transplanted into a propagation bed in April. The plants are shown in the July 30, 2011 photo to the left.

The first year's growth will be harvested as whips prior to breaking dormancy in the Spring of 2012, and used to establish an initial test plot. Another test plot using whips from native Black willow will be established at the same time. Importantly, the original koriyanagi stools or

stumps will be monitored to measure regeneration and survival rates as well as the number and size of new shoots produced.

7.0 APPENDICES

Biomass Activity Notes

1. Replication of a method of vegetative propagation for giant reed Giant reed, *Arundo donax*, has the potential to annually produce 20 to 25 dry tons of biomass per acre. Widely cultivated in Asia and the Mediterranean region, for its bamboo-like woody culms, the perennial plant requires few inputs, has a 15-20 year productive life, and its large rhizome and root system sequesters large volumes of carbon. High establishment costs have been the major barrier to wider commercial cultivation as a crop since *Arundo* is a sterile plant. Until recently, vegetative propagation has either involved transplanting rhizomes from established stands into new fields or micropropagation of plantlets in the laboratory.

One characteristic of *Arundo* is that the culms, or reeds, which may reach 20 feet in height, produce no side branches during its initial year of growth. Once the plant breaks senescence in the second year, side branches will develop from nodes that develop 3 to 12 inches apart along the reed. In late 2010, two Italian researchers published a description of a promising method of propagating *Arundo* using second year culms that had established branches (E Ceotto & M Candilo, Shoot cuttings propagation of giant reed (*Arundo donax* L.) in water and moist soil: The path forward?. *Biomass and Bioenergy* 34, 1614-1623). Their method involved cutting the reeds



and soaking the them in order to induce rooting at the nodes. These rooted branches can then either be removed from the stem and prepared for transplanting in the field or the entire section of the stem can be directly placed in a furrow in the field and covered with soil.

On March 24th, eight second year culms which had already established side branches were harvested, cut to approximately 36" and put in a water filled bed to see if Ceotto and Candilo's results could be replicated. After only two weeks, approximately 40% of all nodes show some evidence of root formation. Some cuttings, particularly those with smaller diameter from the top of the culm had nearly complete root establishment.



2. Woody biomass crops

Approximately 200 black willow cuttings have been started so that test plots for short rotation willow production can be established. Dormant cuttings were made in early march and then placed in Jiffy Forestry Pellets. The test plots will be planted in May.



Short rotation test plots will also be established for sycamore and sweet gums with trees started from seed collected in the fall of 2011.



Koriyanagi willow is an Asian willow recommended by Plant Resource Center at Coffeerville, MS for use in the Delta. Because of it is more of a shrub than the native Black willow and is known to coppice –grow back when cut— it may have potential as a short rotation woody crop. A bed of 48 koriyanagi willows was established in 2011 and cut on March 9th. Because of the extremely warm weather in late February and early March, the plants had already begun budding and leaf production when they were cut. Nevertheless, all but one of the 48 plants successfully produced new shoots. The number of shoots per plants ranged from one to ten.



3. Miscanthus

The early spring meant that the miscanthus broke dormancy in February, and as the picture below shows, topped four feet in height on Easter, April 8.





The picture on the left, taken on April 8, shows that rooting had just started and few primary shoots had emerged.

The top and bottom pictures, taken April 15, shows the emergence of vigorous plantlets with strong root structures at almost every node along the culm. Each section of reed can simply be planted in a furrow and covered with soil at this stage, and you will have 10-12 ft. reeds by fall.

My conclusion is that the propagation problem for arundo donax is largely solved



8.0 CONCLUSIONS AND RECOMMENDATIONS

The activities of this project did realize an increase in applications for NRCS and other USDA services. The major impeding factors and barriers can be mitigated and overcome through training and technical assistance. In many cases due to a lack of computer skills, e.g., the ability to receive and submit online information, farmers tend to avoid interfacing with government organizations. Community base organizations such as ALFDC can help in this by providing basic computer training sufficient to submit online information and to browse the very web sites for information pertinent to their farming operations. Financial literacy training is also needed.

Although many participants have been farming for many years, the current era of sustainable agriculture is foreign to them. The necessity of implementing conservation practices is yet to be realized in many instances. Therefore it seems absolutely essential that training and technical assistance be continually provided to these underserved farmers to help them survive by overcoming barriers which in many cases were not of their own making.

9.0 TECHNOLOGY REVIEW CRITERIA

Technologies reviewed for this project focused on tools and methodologies relating to soil nutrient management, resulting in the production of a fact sheet and a management plan. The fact sheet is shown below.

New Technology and Innovative Approach Fact Sheet

Why measure chlorophyll?

Chlorophyll is the green pigment that allows plants to photosynthesize. This process uses sunlight to convert carbon dioxide and water into the building blocks of plants. Because nitrogen is a part of chlorophyll, by measuring chlorophyll, one can indirectly measure the amount of nitrogen in the plant. This allows for more efficient scheduling of fertilizer



SPAD 302 Plus Chlorophyll Meter quantifies the health of your crops *



Use an iPhone, iPad Touch, or iPad, with the FieldScout GreenIndex+ App to capture and compute the DDCI of your plants, and indicate their chlorophyll/nitrogen levels*



FieldScout CM 1000 Chlorophyll Meter *

Soil moisture plays a key role in the life of the plant. Nutrients in the soil solution provide the plant with the food it needs to grow. Water is also essential for regulating plant temperature through the process of transpiration. Plant root systems are better developed when growing in moist soil. Excessive levels of soil moisture, however, can lead to anaerobic conditions that can promote the growth of plant and soil pathogens.



Soil Moisture Meter*



Soil Moisture Sensor*



Why Measure compaction?

The soil is the plant's reservoir of water, nutrients and oxygen. Compacted soil has less pore space to store what the plant needs. Soil compaction prevents moisture penetration, reduces fertilizer and chemical uptake, creates conditions for anaerobic microbes to build up and hinders plant root growth. In some cases, yield losses can run as high as 30% due to compaction alone.



Soil Compaction Meter



Soil Compaction Tester



Turf Firmness Meter

*Spectrum Technologies, Inc.

New Technology and Innovative Approach Fact Sheet

Plant nutrition is only one of more than fifty factors which directly affect both crop yield and quality. The availability of required nutrients, together with the degree of interaction between these nutrients and the soil, play a vital role in crop development. A deficiency in any one required nutrient or soil condition that limits or prevents a metabolic function from occurring can limit plant growth. Soil testing is the base for management decisions about fertilizer requirements. It involves the estimation and evaluation of the available nutrient status and acidic reaction of a sample of soil. After testing, a fertility map should be prepared where the available nitrogen, phosphorous and potassium can be marked as low, medium or high. Areas of sufficient and insufficient nutrients may be marked out and nutritional requirements can be determined. Fertilizers such as NPK, lime or gypsum can be recommended to improve soil fertility. Fertilizer addition, which is based on soil testing, usually leads to an increase in yields and profits by providing the correct amounts of needed nutrients. It also leads to uniform applications of nutrients in a field. As nutrient availability becomes less variable, the crop growth is more uniform. Regular soil testing also contributes to environmental sustainability as the use of excess fertilizers can be avoided. Keeping in mind the requirements and significance of the soil nutrient analysis, ACMAS Technologies PVT. LTD has developed a compact micro processor based soil nutrient analysis system. The soil nutrient analyzer can quickly test the N, P, K, humic acid, organic matter, salinity, and PH in the soil, fertilizer and plants, and also can have a computer connectivity to log on the data in the system.

Soil Nutrient Analysis Meter (ACM-SNA-2677)



Based on advance electronic technology for soil analysis, water analysis, pollution control, laboratory analysis, soil testing etc. Complete unit is housed in a briefcase to work on battery rechargeable cum mains. Unit is supplied without O.R.P. electrode with instruction manual.

The sampling of soil in liquid state has always been of great concern to scientists and researchers for the simple reason whether or not its original characteristics are intact.

Wolter's Suction Pressure Type Soil Suction Sampler is ideal equipment for soil solution sampling at site by use of suction pressure- positive or negative. Our soil solution sampler is useful for supervising the changes in composition of chemical compounds of soil and also, for repetitive soil sampling procedures.



Digital Soil Analysis Kit (ACM-SAK-2681)



Soil Suction Sampler (ACM-SSS-2676)

Best Management Practices(BMPs)

BMPs are farming methods that assure optimum plant growth and minimize adverse environmental effects. The BMPs presented here are directed primarily toward minimizing environmental damage from nitrogen and phosphorous. A more inclusive set of BMPs is provided in the Nutrient Management Plan.

- 1. Get a Soil Test.** Nutrients should be applied to soils only as necessary. To know the soil's nutrient-supplying capacity, you must have it analyzed by a soil test laboratory.
- 2. Follow Soil Test Recommendations.** A soil test report indicates the amount of nutrients that the soil can supply and recommends the amount, if any needed from other sources. The test also recommends the amount and kind of lime to apply if the pH is too low. All of the recommendations should be followed completely because a deficiency of one nutrient or an undesirable soil pH will limit crop response to the other nutrients.
- 3. Set Realistic Yield Goals.** All fertilizer recommendations assume a certain yield goal for the crop to be grown. Some laboratories ask for your goal, whereas others use an average number. The yield history of a field is the best guide to realistic expectations. Also, county soil surveys include crop yield estimates by soil series. Factors such as the soil's moisture supplying capacity should be considered.
- 4. Choose the Most Suitable Nitrogen Sources.** It is important that nitrogen remain in the root zone long enough for it to be used by the growing crop. Regardless of its source, once nitrogen is in the plant it will not be lost and will not become a pollutant.
- 5. Apply Nitrogen and Phosphorus Correctly.** Nitrogen and phosphorus are less likely to be lost by erosion or runoff if they are banded directly into the soil or applied to the soil surface and promptly mixed into the soil by disking, plowing, or rotary tilling. Subsurface banding also makes it possible for nutrients to be placed directly where the crop can make the best use of them.
- 6. Time Nitrogen Applications Appropriately.** The timing of application is more important with nitrogen than with any other nutrient because nitrogen is applied in large amounts to many crops and is very mobile. Phosphorus is very stable once it is mixed into the soil and can be applied when most convenient.
- 7. Use Manure as a Nutrient Source.** Manure and other waste or by-product materials can be excellent sources of nutrients if managed properly. The basic procedure is to collect and analyze the material to determine the nutrient content and then apply it in a recommended manner at rates based on a soil test report.
- 8. Control Erosion.** All nutrients can be lost when soil is eroded, but phosphorus is especially vulnerable. The primary way to prevent phosphorus loss is to control erosion. A conservation farm plan providing for erosion control should be developed. Use conservation tillage and other erosion-control practices to minimize loss of phosphorus that is attached to the soil.
- 9. Manage Water Flow.** Water management is closely related to erosion control, and some practices overlap. In general, erosion is minimized when water flow is slowed or stopped.
- 10. Fence Animals Away from Streams, Drains and Critical Areas.** The first step in manure nutrient management is to control where the manure is deposited.